and the lines therefore appear single. Hence, during a complete revolution the lines will twice reach a maximum separation and twice appear single. The principal lines in the spectrum of α Lyræ are due to hydrogen. These do not exhibit a duplication, because the separation is less than their thickness. A variation in their width, however, is very obvious. The K line of calcium is the next strongest, and is sufficiently fine and distinct to render the duplicity very apparent. Fourteen photographs of the spectrum have been taken from October 3 to November 4. The maximum separation of the K line was recorded on October 8 as 7·8 tenth-metres. On October 17, 28, and November 1, 8 p.m., the same line appeared single. At 8.30 p.m. and 10 p.m. on the last-named date, the separation was respectively 2·3 and 3·8 tenth-metres. A discussion of the data obtained from all the photographs shows that they are fairly satisfied by assuming a circular orbit, the plane of which passes through the sun, and the remarkably short period of revolution of about 24·68 hours. This period does not appear inconsistent with the relative orbital velocity of 370 miles per second indicated by the photograph taken on October 8, and is confirmed by the three photographs taken at short intervals on November 1. If 370 miles per second be taken as the maximum relative orbital velocity, the distance between the components is about 5,000,000 miles. The total mass will therefore be about 22·5 times that of the sun, and as there is no appreciable difference in the intensity of the K lines, the masses of the components are probably about equal. In the cases of β Aurigæ and ζ Ursæ Majoris, Prof. Pickering found, respectively, periods of 4 and 52 days, and maximum orbital velocities of about 150 and 100 miles per second.

PARALLAXES OF NEBULÆ.—Prof. Holden proposes to determine the parallaxes of nebulæ by taking short exposure photographs of their nuclei, and measuring their positions relative to neighbouring stars, in a similar manner to the method adopted by Prof. Pritchard for the photographic determination of the parallaxes of stars. A short exposure photograph taken at Lick Observatory, of Σ 6 and the stars near it, indicates that the method is one from which good results may be obtained.

CATANIA OBSERVATORY.—Prof. Riccò has been appointed Director of the new Catania Observatory. The work of the Observatory will be principally connected with astronomical physics, celestial photography, meteorology, and seismology.

WASHINGTON OBSERVATIONS, APPENDIX II.—This consists of an account of the work done by Mr. Asaph Hall, on Saturn and its ring, extending over the years 1875–89. Besides giving details of every observation made by him, he sums up afterwards the results obtained, from which we gather the following information. From a series of observations of the white spot on the equator of the planet, he finds the time of rotation of Saturn to be 10h. 14m. 23·8s. ± 2·30s. mean time: this differs slightly from that obtained by Sir William Herschel, who gave 10h. 16m. 0·4s., and said that his result could not be in error by so much as two minutes. The ball of the planet during the fourteen years of observation has undergone very slight changes, with the exception of the white spot which broke out on December 7, 1876. Although a careful examination was made to find if a notch could be seen in the outline of the shadow of the ball on the ring, no such phenomenon was recorded. Of the principal rings, no division was recorded in the inner ring. The Cassini division gave the impression "of not being a complete separation, or that small particles of matter remain in this partly dark space." The Encke division of the outer ring, although specially looked for could not be definitely stated as a "real and permanent division," although a slight marking was seen at times.

In addition to numerous tables of measurements of the ball and of the various rings, the author adds three plates of the planet as it appeared under favourable conditions in the opposition of 1884.

BIOLOGICAL NOTES.

RATE OF GROWTH IN CORALS.—But little is as yet known as to the rate of growth of corals under different conditions. In the third edition of Dana's "Coral and Coral Islands," a *résumé* will be found of all that is known about this subject up to 1890, but some very interesting details have been published by Alexander Agassiz in the August number of the *Bulletin of the Museum of Comparative Zoology at Harvard College.* A series of specimens are figured, which have been taken off the telegraph cable laid between Havana and Key West, in June 1888, from a portion that was repaired in the summer of 1881; so that the growths could not be more than about seven years old. It is to be observed that this portion of the cable was laid at a depth of only from six to seven fathoms, and that the district in which it was laid was most favourably situated as regards food supply to the corals. Some of the specimens belong to species whose rates of growth have not yet been recorded; they are as follows:—*Orbicella annularis,* figured on plates 1 and 2. Verrill mentions that the thickness of this coral formed in sixty-four years was not more than about 8 inches; the specimens from the Havana cable grew to a thickness of 2½ inches in about seven years. *Manicina areolata,* Ehrenb., figured on plate 3, has grown to a thickness of 1 inch; while *Isophylla dipsacea,* Ag., figured on plate 4, shows a still more rapid growth, projecting 2½ inches above the cable. Of course it is quite possible that these corals are of less than seven years' growth, but it is not probable that more than a short time passed before some of the swarms of pelagic coral embryos which must have floated past the cable found a place of attachment thereon.

TUOMEYA FLUVIATILIS, HARVEY.—Over three-and-thirty years ago the late Prof. W. H. Harvey bestowed this name on a rare and curious freshwater Alga sent to him from the United States by Prof. Tuomey, of Alabama. Harvey's description was published in the third part of his "Nereis Boreali Americana," but Harvey, as was his wont, sent a scrap of his plant to Kuetzing, who at once described and figured it as *Baileya americana.* Prof. Farlow gives the priority to Harvey's name, and we believe he is right. The systematic position of this little Alga is a matter of some importance. Harvey says, "The plants referred to Batrachospermeæ naturally group themselves into two sub-orders, distinguished from each other by the habit of the frond, but closely related in structure and fructification, and these seem to me inseparably connected by the genus Tuomeya, which unites in itself the characters of the seemingly so dissimilar genera Batrachospermum and Lemanea;" but the specimens at his command were too imperfect to enable the complete structure to be made out, and until the other day no light was thrown upon the subject. In December 1888, Mr. Holden found the species in some quantity in a brook near Bridgeport, Conn., and since it has turned up in several distant localities in the United States. Mr. W. A. Setchell has lately published the results of a very detailed investigation of the structure and development of this form, as the result of work done in the Cryptogamic Laboratory of Harvard University. It grows on smooth rocks or stones, in brooks or small streams, preferring places where the current is accelerated; in a few rare cases it has occurred upon aquatic grasses; it seems to be easily cultivated, one batch of specimens, even under such treatment, producing the reproductive organs; the plant seldom exceeds 5 cm. in height, and is bushy and rigid, in this latter respect presenting a marked contrast to the larger species of Batrachospermum, which in size, colour, and manner of growth it much resembles, and with which it very frequently grows. When dried, it is non-adherent to paper, resembling in this some of the Lemanea. Each main filament is composed of a single row of cells placed end to end, the apical cell being in a state of active growth, here and there at intervals the older cells of the filament branch out into a di- or trichotomously branched ramellus, of which several may arise from the same node, and the branchlets from these, intertwining as they increase, form a dense mass of cells round the central filamentous axis, and finally make up a hollow cylindrical frond composed of two sets of cells, somewhat resembling the structure seen in some forms of Lemanea. Before, however, this hollow cylinder is fully formed, filaments are given off from the basal portions of the inner cells of the ramelli, which differ from the ramelli cells in being cylindrical and simple. These grow downwards, forming a dense cortical layer around the axis; some, however, grow obliquely outwards, even protruding themselves beyond the outer limits of the frond, and may possibly become detached, forming new plants. Both the antheridia and procarps are to be found on the same plant, but generally on separate portions of the frond; the antheridia in shape, colour, and character of contents exactly agree with those of Batrachospermum; they are borne at the tips of branches which arise from or near the nodes. These mostly pass out horizontally to the surface of the frond. The antheridial branches are at first unbranched; their ends just

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beneath the outer surface of the frond are two or three times branched in a corymbosely dichotomous fashion ; the antheridia are apical, spheroidal ; the antherozoids are solitary ; for a short time after escape they are of an irregular shape, exhibit slight amœboid motion, but soon become globular and motionless. The female organs are borne upon especially modified procarpic branches ; in the axil of one of the ramelli, arise one, sometimes more short branches strikingly different from any of the other outgrowths, made up of broad, stout cells. As these increase in length they generally become spirally twisted, and the cells on their convex sides develop short branches. The terminal cell of the branch produces the procarp, which in Tuomeya consists of a broadly ovoid trichophore, surmounted by a trichogyne several times longer than itself. After fertilization the trichophore begins to bud forth cells, which gradually become arranged in more or less concentric rows upon the surface of the trichophore ; the further development was not seen. but it is surmised that strings of spores are then formed, as in Batrachospermum. Unfortunately the germination of the spores has not been witnessed, nor have very young plants yet been seen. Some further investigations as to the structure of cystocarps is also desirable, but we know that Mr. Setchell is continuing his researches, and we trust these will not end until the whole life-history of this very interesting fresh-water Alga is thoroughly understood. (Proceedings of the American Academy of Arts and Sciences, vol. xxv. p. 53, with a plate.)

MARINE ALGÆ OF BERWICK-ON-TWEED.—Mr. Edward A. L. Batters has recently published, from the Transactions of the Berwickshire Naturalists' Club for 1889, a most useful list of the marine Algæ of Berwick-on-Tweed. Many years have elapsed since the appearance of Dr. Johnston's list, and very numerous have been the alterations in nomenclature since those days. This new list is therefore all the more welcome, as it comes as a contribution towards a revision of the British Algæ, which the great advance in our knowledge that has been made since the publication of Harvey's splendid "Phycologia Brittanica" renders absolutely necessary. Mr. Batters's list contains 271 species. Comparing this with a few local lists conveniently at hand, we find in Le Joli's well-known "Cherbourg Algal Flora" 350 species ; Debray, "Catalogue of the Algæ found at Dunkirk," gives 189 species ; while Flahault's interesting account of his collecting for some six weeks at Croisic details 230 forms. Of those enumerated in the Berwick list no less than 78 species have been added to the British flora since the publication of Harvey's work. One minute form found presenting the appearance of tiny yellow-brown patches has been made by Reinke a new genus, Battersia ; it belongs to the Sphacelariaceæ, and has doubtless been often overlooked. From a small encrusting thallus little patches of fruit bearing filaments arise. Several of the Algæ lately described by Bornet and Flahault as perforating species, chiefly in the substance of marine shells, such as *Gomontia polyrhiza* and *Mastigocoleus testarum*, are recorded. There is an index of genera and also figures of most of the new species.

DR. KOCH ON TUBERCULOSIS.

A SUPPLEMENT to the *British Medical Journal* contains "A Further Communication on a Remedy for Tuberculosis," translated from the original article published in the *Deutsche Medizinische Wochenschrift*, November 14, by Prof. Dr. Robert Koch, Berlin, as follows :—

Introduction.

In an address delivered before the International Medical Congress I mentioned a remedy which conferred on the animals experimented on an immunity against inoculation with the tubercle bacillus, and which arrests tuberculous disease. Investigations have now been carried out on human patients, and these form the subject of the following observations.

It was originally my intention to complete the research, and especially to gain sufficient experience regarding the application of the remedy in practice and its production on a large scale, before publishing anything on the subject. But, in spite of all precautions, too many accounts have reached the public, and that in an exaggerated and distorted form, so that it seems imperative, in order to prevent all false impressions, to give at once a review of the position of the subject at the present stage of the inquiry. It is true that this review can, under these circumstances, be only brief, and must leave open many important questions.

The investigations have been carried on under my direction by Dr. A. Libbertz and Stabsarzt Dr. E. Pfühl, and are still in progress. Patients were placed at my disposal by Prof. Brieger from his Poliklinik, Dr. W. Levy from his private surgical clinic, Geheimrath Dr. Fräntzel and Oberstabsarzt Kohler from the Charité Hospital, and Geheimrath v. Bergmann from the Surgical Clinic of the University.[1]

Nature and Physical Characters of the Remedy.

As regards the origin and the preparation of the remedy I am unable to make any statement, as my research is not yet concluded : I reserve this for a future communication.[2] The remedy is a brownish transparent liquid, which does not require special care to prevent decomposition. For use, this fluid must be more or less diluted, and the dilutions are liable to decomposition if prepared with distilled water ; bacterial growths soon develop in them, they become turbid, and are then unfit for use. To prevent this the diluted liquid must be sterilized by heat and preserved under a cotton-wool stopper ; or more conveniently prepared with a ½ per cent. solution of phenol.

Manner of using the Remedy.

It would seem, however, that the effect is weakened both by frequent heating and by mixture with phenol solution, and I have therefore always made use of freshly-prepared solutions. Introduced into the stomach, the remedy has no effect ; in order to obtain a trustworthy effect, it must be injected subcutaneously. For this purpose we have used exclusively the small syringe suggested by me for bacteriological work ; it is furnished with a small india-rubber ball, and has no piston. This syringe can easily be kept aseptic by absolute alcohol, and to this we attribute the fact that not a single abscess has been observed in the course of more than a thousand subcutaneous injections. The place chosen for the injection—after several trials of other places—was the skin of the back between the shoulder-blades and the lumbar region, because here the injection led to the least local reaction—generally none at all—and was almost painless.

Effect of Injections in Healthy Individuals.

As regards the effect of the remedy on the human patient, it was clear from the beginning of the research that in one very important point the human being reacts to the remedy differently from the animal generally used in experiments—the guinea-pig ; a new proof for the experimenter of the all-important law that experiment on animals is not conclusive for the human being, for the human patient proved extraordinarily more sensitive than the guinea-pig as regards the effect of the remedy. A healthy guinea-pig will bear two cubic centimetres and even more of the liquid injected subcutaneously without being sensibly affected. But in the case of a full-grown healthy man 0·25 cubic centimetres suffice to produce an intense effect. Calculated by body weight, the 1500th part of the quantity, which has no appreciable effect on the guinea-pig, acts powerfully on the human being. The symptoms arising from an injection of 0·25 cubic centimetre I have observed after an injection made in my own upper arm. They were briefly as follows :—Three to four hours after the injection there came on pains in the limbs, fatigue, inclination to cough, difficulty in breathing, which speedily increased. In the fifth hour an unusually violent attack of ague followed, which lasted almost an hour. At the same time there was sickness, vomiting, and rise of body temperature up to 39°·6 C. After twelve hours all these symptoms abated. The temperature fell, until next day it was normal, and a feeling of fatigue and pain in the limbs continued for a few days, and for exactly the same period of time the site of injection remained slightly painful and red. The lowest limit of the effect of the remedy for a healthy human being is about 0·01 cubic centimetre (equal to 1 cubic centimetre of the hundredth solution), as has been proved by numerous experiments. When this dose was used, reaction in most people showed itself only by slight pains in the limbs and transient fatigue. A few showed a slight rise of temperature up to about 38° C. Although the dosage of the

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[1] Dr. Koch here expressed his thanks to these gentlemen.

[2] Doctors wishing to make investigations with the remedy at present can obtain it from Dr. A. Libbertz, Lueneburger Strasse 28, Berlin, N.W., who has undertaken the preparation of the remedy, with my own and Dr. Pfühl's co-operation. But I must remark that the quantity prepared at present is but small, and that larger quantities will not be obtainable for some weeks.

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